Australian Bureau of Statistics

6298.0

Labour Force Survey Standard Errors

2005

100 years of STATISTICS

www.abs.gov.au

Labour Force Survey Standard Errors

2005

Peter Harper
Acting Australian Statistician

AUSTRALIAN BUREAU OF STATISTICS

EMBARGO: 11.30AM (CANBERRA TIME) THURS 8 SEP 2005

ABS Catalogue No. 6298.0

ISBN 0 642 47850 3

Produced by the Australian Bureau of Statistics

INQUIRIES

- For further information about these and related statistics, contact the National Information and Referral Service on 1300 135 070 or Craig Blair on Canberra (02) 6252 5967.

CONTENTS

ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
Aust.	Australia
CAI	computer assisted interviewing
LFS	Labour Force Survey
NSW	New South Wales
NT	Northern Territory
Qld	Queensland
RSE	relative standard error
SA	South Australia
SE	standard error
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia

INTRODUCTION

LABOUR FORCE SURVEY

The Australian Bureau of Statistics (ABS) has been conducting the Labour Force Survey (LFS) since 1960. Originally the survey was conducted quarterly, before becoming monthly in February 1978. The LFS provides timely information on the labour market activity of the usually resident civilian population of Australia aged 15 years and over.

The sample for the LFS is designed to ensure that the reliability and accuracy of key estimates are maximised, within the cost and other constraints imposed. Every five years, following the availability of data from the Census of Population and Housing, the ABS reviews the LFS sample design. While the design has remained broadly the same since the introduction of the monthly LFS, the review ensures that the survey continues to accurately reflect the geographic distribution of the Australian population, and remains efficient and cost-effective. A new sample design, based on 2001 census data, was phased-in from November 2002 to June 2003. For information about the sample design, see *Information Paper: Labour Force Survey Sample Design* (cat. no. 6269.0), released on 4 December 2002.

RELIABILITY

While the reliability and accuracy of estimates are maximised through the sample design, estimates from the LFS, as with data from all surveys, are subject to error. It is important to consider these errors when using LFS estimates as they affect the accuracy of the estimates and, therefore, the importance that can be placed on interpretations drawn from the data.

Survey estimates are subject to two types of error:

- non-sampling error, which arises from imperfections in reporting, recording or processing of the data that can occur in any survey or census.
- sampling error, which occurs because data were obtained from a sample rather than the entire population.

Non-sampling error is difficult to quantify and there are no standard measures of non-sampling error produced for ABS surveys. Every effort is made in the design and operation of the LFS to minimise non-sampling error.

The most commonly used measure of sampling error is the standard error (SE). This measure indicates the extent to which a survey estimate is likely to deviate from the true population value by chance.

Information about standard errors is provided for most ABS surveys. For the LFS, standard errors of selected estimates have been mathematically modelled as a function of the estimate itself. This approach simplifies the calculation of standard errors, as it enables approximate standard errors to be calculated without needing records of individuals or sampling details.

CONTENT OF THIS PAPER

This paper provides basic information on the sample design of the LFS, and shows how to calculate standard errors for a wide range of LFS estimates. The standard error models presented in this paper apply to LFS level estimates from November 2002 onwards, and to monthly movement estimates from the December 2002 to January 2003 movement onwards. The standard errors in this publication apply to original estimates; they are not applicable to seasonally adjusted and trend estimates — see the section 'Standard errors in the Labour Force Survey' for more information.

CONTENT OF THIS PAPER *continued*

Approximate standard errors can be calculated directly from the models, using the formulae provided in the 'Standard error models' section, or from the spreadsheet available free on the ABS web site at <http://www.abs.gov.au> (*Themes — People — Labour — LFS Standard Errors*). Alternatively, an indication of the magnitude of the standard error can be quickly interpolated from the standard error tables (based on the standard error models) that are included in the additional information section. Examples showing how to use these tables for level and monthly movement estimates are also included. Note that standard errors interpolated using the tables are slightly less accurate than those calculated using the formulae.

Each month, standard errors for the main labour force estimates for that month (level estimates) and standard errors for the differences between the current and previous month's estimates (monthly movement estimates) are published in *Labour Force, Australia* (cat. no. 6202.0). These standard errors are calculated using the formulae provided in the 'Standard error models' section. This paper is intended to supplement existing information on the reliability of LFS estimates, and allows the calculation of standard errors for any level or monthly movement estimate.

Descriptions of the underlying concepts and structure of Australia's labour force statistics, and of the sources and methods used in compiling the estimates, are presented in *Labour Statistics: Concepts, Sources and Methods* (cat. no. 6102.0.55.001) which is available free of charge on the ABS web site at <http://www.abs.gov.au> (*Methods*, *Classifications, Concepts & Standards*).

MODELS AND TABLES IN THIS ISSUE

The standard error models and tables in this paper reflect the current sample design which is based on the 2001 census (introduced into the LFS between November 2002 and June 2003). Information on the standard error models of the previous sample design is available in *Information Paper: Labour Force Survey Standard Errors, 2003* (cat. no. 6298.0). Information on standard errors of earlier sample designs can be found in *Labour Force, Australia* (cat. no. 6203.0), which was last published on 28 March 2003.

A new issue of *Labour Force Survey Standard Errors*, with standard error models and tables reflecting the sample design based on the 2006 census, will be released in mid-2009.

SAMPLE DESIGN AND SURVEY METHODOLOGY

SAMPLE DESIGN

The LFS is designed primarily to provide reliable estimates of key labour force aggregates for the whole of Australia and, secondarily, for each state and territory.

The most accurate national estimates would be obtained if the total sample for Australia were distributed to the states and territories in proportion to their populations. However, for all states or territories to have estimates as accurate as one another (that is, relative standard errors about the same magnitude), approximately equal size samples would be needed.

The actual distribution of the sample across states and territories is a compromise between a sample that would be optimum for national purposes and one that would afford each state and territory the same accuracy. That is, the proportion of the population that is sampled (known as the sampling fraction) differs across states and territories, but not to the extent that they have identical sample sizes (and hence identical accuracy). Within each state or territory, each dwelling has the same probability of selection. The sampling fractions resulting from the 2001 LFS sample redesign are shown in the table below.

LABOUR FORCE SURVEY: 2001 SAMPLE REDESIGN

State or territory	*Sampling Fraction*
New South Wales	1 in 321
Victoria	1 in 270
Queensland	1 in 239
South Australia	1 in 149
Western Australia	1 in 165
Tasmania	1 in 90
Northern Territory	1 in 98
Australian Capital Territory	1 in 86
Australia	1 in 224

For more information on the 2001 sample design, see *Information Paper: Labour Force Survey Sample Design* (cat. no. 6269.0), released on 4 December 2002.

SAMPLE ROTATION

One of the primary requirements of the LFS is to provide a measure of change in the characteristics of the labour force over time, especially month-to-month change.

Standard errors of monthly change could be minimised by collecting data from essentially the same sample of dwellings each month (while ensuring that new dwellings in the population are represented). However, it is undesirable to require respondents to be retained in the survey indefinitely, so a proportion of the sample is replaced each month. This procedure is known as sample rotation.

Since the monthly LFS began in 1978, approximately one-eighth of the sample has generally been replaced each month. The LFS sample can be thought of as consisting of eight sub-samples (or rotation groups), with a new rotation group being introduced into the sample each month to replace an outgoing rotation group. This replacement one-eighth sample usually comes from the same area as the outgoing one.

SAMPLE ROTATION *continued*

The sample rotation method used in the LFS enables reliable estimates of monthly change in labour force characteristics to be compiled, as seven-eighths of the sample from one month is retained for the next month's survey. At the same time, the sample rotation method ensures that no dwelling is retained in the sample for more than eight months.

COLLECTION METHODOLOGY

LFS information is collected from the occupants of selected dwellings by specially trained interviewers. Interviews are generally conducted during the two weeks beginning on the Monday between the 6th and the 12th of each month. The information obtained relates to the week before the interview (i.e. the reference week).

Prior to August 1996, all interviews were conducted face-to-face. Over the period August 1996 to February 1997, the ABS introduced telephone interviewing to collect LFS data. With telephone interviewing, the first interview is conducted face-to-face and subsequent interviews are conducted by telephone (where this is acceptable to the respondent).

Information is collected using computer-assisted interviewing (CAI) whereby responses are recorded directly onto an electronic questionnaire on a notebook computer. The CAI method was progressively implemented from October 2003 to August 2004, replacing the 'pen and paper' method previously used.

Interviewers may collect all information about each household member within the scope of the survey from the first responsible adult with whom the interviewer makes contact (rather than speaking to each individual personally). Where the person interviewed is unable to supply all of the details for another member of the household, the latter individual may be interviewed personally.

SCOPE AND COVERAGE

The scope of a survey is the population for which estimates are required. In the LFS, scope is restricted to the usually resident civilian population of Australia aged 15 years and over.

In the LFS, coverage rules are applied which aim to ensure that each person is associated with only one dwelling, and hence has only one chance of selection. Information for persons who are away from their usual residence for six weeks or less at the time of interview is provided by another usual resident present at the dwelling at the time of the survey. The chance of a person being enumerated at two separate dwellings in the one survey is considered to be negligible.

LFS estimates are calculated in such a way as to add up to independently estimated counts (benchmarks) of the usually resident civilian population aged 15 years and over, a procedure which compensates for any under-enumeration in the survey. From February 2004, labour force estimates have been compiled using benchmarks based on the 2001 Census of Population and Housing.

For more information on LFS methodology, see *Labour Statistics: Concepts, Sources and Methods* (cat. no. 6102.0.55.001), which is available on the ABS website at <http://www.abs.gov.au> (*Methods, Classifications, Concepts & Standards*).

MEASURES OF SAMPLING ERROR

SAMPLING ERROR

Sampling error is the difference between the estimate obtained from a particular sample and the value that would be obtained if the whole population were enumerated under the same procedures (referred to here as the 'population value'). As LFS estimates are based on information gathered from the occupants of a sample of dwellings, rather than all dwellings, they are subject to sampling error.

STANDARD ERROR

Although the sampling error for a particular sample is unknown (because the population value is unknown), the use of probability samples enables an estimate of the likely magnitude of the sampling error to be made from the sample. The standard error of an estimate is a measure of the variation among the estimates from all possible samples, and thus a measure of the precision with which an estimate from a particular sample approximates the average over all possible samples (i.e. the population value). That is, standard errors indicate how close the survey estimate is likely to be to the population value.

As standard errors are usually calculated or modelled from sample survey data, they are also subject to sampling error. Different random samples will produce different standard errors.

CONFIDENCE INTERVALS

Confidence intervals represent the range in which the population value is likely to lie. They are constructed using the estimate of the population value and its associated standard error. Different confidence intervals can be created to represent different chances that the population value will lie within the range. For example, there is approximately a 95% chance (i.e. 19 chances in 20) that the population value lies within two standard errors of the estimate, so the 95% confidence interval is equal to the estimate plus or minus two standard errors.

RELATIVE STANDARD ERROR

Another measure of sampling error is the relative standard error (RSE). The RSE is the standard error expressed as a fraction of the estimate, and is usually displayed as a percentage. The standard error of an estimate generally increases with the size of the estimate, therefore a large standard error may not necessarily reflect poor accuracy. It is often more relevant to compare relative accuracies when comparing two estimates. The RSE avoids the need to refer to the size of the estimate, since the standard error is expressed as a proportion of the estimate. RSEs are a useful measure in that they provide an immediate indication of the percentage error likely to have occurred due to sampling.

Very small estimates tend to be subject to high RSEs which detract from their usefulness. In LFS publications, only estimates with RSEs of less than 25% are considered sufficiently reliable for most purposes. Estimates with larger RSEs are marked with an asterisk (*) to indicate they are subject to high sampling errors and should be used with caution.

Note: Relative standard error, as defined in this paper, should not be used for LFS movement estimates.

STANDARD ERRORS FOR LFS ESTIMATES

Separate standard errors could be calculated for each individual LFS estimate for each time period. However, this would be costly; would require information on the sample design; and would require access to the unit record data. To simplify calculation of standard errors (and to save costs), models have been fitted to the directly calculated standard errors for each estimate (for a particular period). These models are then used to calculate approximate standard errors for other periods using only information on the size and type of the estimate for which the standard error is required.

Following previous sample redesigns, a single standard error model was prepared for level estimates, and another for monthly movement estimates. These models were used to calculate the standard errors for all labour force status types, and as a result of their broad basis, had the effect of underestimating some standard errors while overestimating others. To improve the accuracy of the models following the 2001 sample redesign, three models were prepared for level estimates (one for each labour force status type: employed, unemployed, and not in the labour force) and another three for the respective monthly movement estimates. Using three separate standard error models ensures that the resultant standard errors more closely reflect the directly calculated standard errors than was possible with only one compromise model.

Methods used for calculating standard errors

The method used to directly calculate standard errors for LFS estimates is the group jack-knife method. The exception is standard errors on rates and movements of rates. The calculation of these depends on the standard errors associated with the numerator and denominator, as well as the correlations between these.

The models were created based on standard errors calculated using the group jack-knife method for estimates of employed, unemployed and persons not in the labour force, cross classified by sex, age, marital status, state, territory, capital city and balance of state. Standard error models have been developed separately for each labour force status, in each state, territory, and Australia. A single model for standard errors of all labour force status types proved sufficient for LFS regions.

Seasonally adjusted and trend estimates

Standard errors in this publication apply to original estimates; they are not applicable to seasonally adjusted or trend estimates. Work has commenced on developing methods to produce accurate standard errors for seasonally adjusted and trend estimates. In the meantime, a reasonable approximation can be made for the standard errors of seasonally adjusted estimates (although not of trend estimates) using the standard errors for original estimates, as presented in this paper.

Publication of standard errors

Due to space limitations within paper publications, it is impractical to print a standard error for each LFS estimate published. Rather, the ABS marks estimates with an RSE of 25% or greater with an asterisk (*) to indicate they are not sufficiently reliable for most purposes. If an estimate of the standard error is required, it can be calculated using the model formulae included in the spreadsheet which is available free on the ABS web site <http://www.abs.gov.au> (*Themes — People — Labour — LFS Standard Errors*).

Publication of standard errors continued

The formulae are also provided in the 'Standard error models' section of this paper. These standard errors are applicable to all original LFS estimates, including those in:

- publications *Labour Force, Australia* (cat. no. 6202.0) and *Australian Labour Market Statistics* (cat. no. 6105.0)
- electronic LFS products such as time series spreadsheets and data cubes
- LFS data included in other ABS publications and special data requests.

Using the standard error model formulae

The standard error model formulae and parameters for both level and monthly movement standard errors have been included in the 'Standard error models' section. Approximate standard errors can be calculated using these formulae and the parameters. To assist users, these formulae have been used as the basis for a spreadsheet that can produce the approximate standard error and relative standard error for any LFS estimate entered (including rates). For detailed information on how to use the spreadsheet, refer to the 'Examples of calculations' section. The spreadsheet is available free on the ABS web site <http://www.abs.gov.au> (*Themes — People — Labour — LFS Standard Errors*).

Standard error tables

This publication also contains standard error tables for the various level and monthly movement models. These tables (in the 'Additional information' section) show the resulting standard error when the formulae and parameters are applied to a selection of estimates. A standard error for a specific estimate can then be interpolated between two estimates. While these tables can quickly enable an indication of the magnitude of a standard error, using the formulae (as in the spreadsheet) will provide a more accurate standard error.

- Tables 1a, 1b and 1c can be used to interpolate standard errors for level estimates of persons employed, unemployed or not in the labour force for the states, territories or Australia.
- Tables 2a, 2b and 2c can be used to interpolate standard errors for monthly movements of estimates (i.e. the difference between estimates for two consecutive months) of persons employed, unemployed or not in the labour force for the states, territories or Australia.

Additional tables

The standard error models apply to estimates of counts of persons (i.e. to the majority of estimates published from the LFS). Some adjustments are needed for several other published variables, and so two additional tables are provided to assist in determining the reliability of these estimates:

- Table 3 provides factors to enable the calculation of standard errors or RSEs for estimates such as hours worked, duration of unemployment, averages, and movements other than monthly.
- Table 4 provides an indication of whether the RSE of a particular estimate is greater or less than 25%. Estimates with an RSE of 25% or greater are not considered to be sufficiently reliable for most purposes, and should be treated with caution. The numbers in table 4 relate to estimates of persons. For most estimates, the cut-offs for 'all other estimates' should be used — separate cut-offs are given for estimates of hours worked and duration of unemployment. Any estimate based on fewer persons than the level indicated in table 4 has an estimated RSE of 25% or greater.

STANDARD ERROR MODELS

STANDARD ERROR MODELS

Standard error models have been developed for labour force estimates of employed, unemployed and not in the labour force for both level and monthly movement estimates. The model formulae are presented here to enable users to calculate standard errors directly from the models, if desired. These formulae have been set up in a spreadsheet available free on the ABS web site <http://www.abs.gov.au> *(Themes—People—Labour—LFS Standard Errors)*, to provide users with the appropriate standard error for any estimate specified.

STANDARD ERROR MODELS FOR LEVEL ESTIMATES

The level estimate standard error models for the LFS are spline models composed of several different parts linked together. For any LFS estimate of number of persons, the modelled RSE is given by the following formula (where logarithms are to base 10):

$$\log(\text{RSE}) = a + b \times [\log(\text{estimate})] + c \times [\log(\text{estimate})]^2 + d \times [\max\{\log(\text{estimate}) - k_1, 0\}]^2 + e \times [\max\{\log(\text{estimate}) - k_2, 0\}]^2$$

The parameters to use in the formula are included in the table 'Parameters to calculate level standard errors' in this section, and depend upon the labour force status and the state or territory of the estimate.

To obtain the standard error of the estimate from the RSE, use the following formula:

$$\text{SE}(\text{estimate}) = (\text{RSE}(\text{estimate}) / 100) \times \text{estimate}$$

Parameters for level estimates

The parameters used in the standard error model formula depend on the type of estimate and the area of interest (i.e. Australia or a particular state, territory or region). The following table is divided into three parts, presenting the parameters (a, b, c, d, e and knots k1 and k2) from the formula above. This formula and parameters can be used to calculate standard errors for estimates of employed, unemployed and not in the labour force. Standard errors for estimates of the labour force can be calculated using the employed parameters. The table includes the parameters for Australia, and the states and territories. Parameters for regions are included in the spreadsheet and are also available upon request.

Parameters for level estimates continued

PARAMETERS TO CALCULATE LEVEL STANDARD ERRORS(a)—November 2002 onwards

State or territory	*a*	*b*	*c*	*d*	*e*	*k1*	*k2*
Employed							
New South Wales	3.60481	–0.57845	–0.00544	0.31671	–0.43798	5.0	5.5
Victoria	3.55122	–0.58324	–0.00425	0.50742	–0.60808	5.0	5.3
Queensland	3.48127	–0.52505	–0.01640	0.22144	–0.54787	4.5	5.5
South Australia	3.09807	–0.41067	–0.03210	0.18996	–0.31348	4.0	5.0
Western Australia	3.10679	–0.41114	–0.02852	0.46887	–0.69549	4.5	5.0
Tasmania	2.40393	–0.01469	–0.10204	0.30869	–0.35695	3.5	4.5
Northern Territory	1.92654	0.26511	–0.13873	0.56316	–0.35629	3.5	4.0
Australian Capital Territory	3.43780	–0.62939	–0.01401	0.21092	–0.51456	3.5	4.5
Australia	1.90477	0.24838	–0.10477	0.18314	–0.35993	4.5	6.5
Unemployed							
New South Wales	2.88705	–0.26588	–0.03421	0.05417	–0.00726	3.5	4.5
Victoria	3.14744	–0.43250	–0.01141	0.03804	–0.24094	3.5	5.0
Queensland	2.87066	–0.28879	–0.03173	0.06587	–0.04112	3.5	4.0
South Australia	3.24099	–0.58651	0.01376	0.00787	–0.07707	3.5	4.0
Western Australia	2.85053	–0.32932	–0.02534	0.07212	–0.09742	3.5	4.0
Tasmania	2.21131	0.04049	–0.09177	0.15913	–0.82796	3.0	4.0
Northern Territory	0.45879	1.27739	–0.29971	0.29253	0.05893	2.8	3.2
Australian Capital Territory	1.69820	0.42454	–0.16443	0.33483	–0.44546	3.0	3.5
Australia	1.22721	0.70864	–0.18067	0.23270	–0.03913	3.5	4.0
Not in the labour force							
New South Wales	2.03783	0.21653	–0.10205	0.22999	–0.33209	4.3	5.5
Victoria	2.80966	–0.19809	–0.05035	0.31773	–0.34791	4.5	5.0
Queensland	2.66908	–0.13802	–0.05785	0.43395	–0.61747	4.5	5.0
South Australia	1.84948	0.33702	–0.13913	0.20633	–0.25422	3.5	5.0
Western Australia	2.23366	0.09615	–0.09683	0.41543	–0.41339	4.0	4.5
Tasmania	2.35473	0.01084	–0.10111	0.44377	–0.44238	3.5	4.0
Northern Territory	3.31502	–0.70229	0.03438	0.29915	–0.44081	3.5	4.0
Australian Capital Territory	1.87475	0.32563	–0.15336	0.60995	–0.70092	3.5	4.0
Australia	2.37026	–0.02748	–0.06324	0.27950	–0.41537	5.0	5.8

(a) For estimates of number of persons.

EXAMPLE

This is an example of how the model formula would be used to calculate the standard error for the LFS estimate of the number of people employed in Australia in November 2004 (9,786,500). The standard error can be calculated from the model formula, using parameters found in the table above:

$$\log(\text{RSE}) = a + b \times [\log(\text{estimate})] + c \times [\log(\text{estimate})]^2 + d \times [\max\{\log(\text{estimate}) - k_1, 0\}]^2 + e \times [\max\{\log(\text{estimate}) - k_2, 0\}]^2$$

$$\begin{aligned}\log(\text{RSE}) &= 1.90477 + 0.24838 \times \log(9{,}786{,}500) - 0.10477 \times [\log(9{,}786{,}500)]^2 \\ &\quad + 0.18314 \times [\max\{\log(9{,}786{,}500) - 4.5, 0\}]^2 \\ &\quad - 0.35993 \times [\max\{\log(9{,}786{,}500) - 6.5, 0\}]^2 \\ &= -0.42947 \\ \text{RSE} &= 0.37199 \\ \text{SE} &= (\text{RSE} / 100) \times \text{estimate} \\ &= (0.37199 / 100) \times 9{,}786{,}500 \\ &= 36{,}405\end{aligned}$$

So, the standard error for the estimate of number of people employed in November 2004 (9,786,500) was 36,400.

Level rates and percentages

Rates and percentages formed from the ratio of two level estimates (for example, unemployment rates) are also subject to sampling errors. When the estimate in the numerator (x) is a sub-set of the estimate in the denominator (y), as in the unemployment rate or participation rate, the RSE of the ratio depends on RSE (x) and RSE (y).

When the denominator (y) in a rate is a population benchmark (as in the labour force participation rate), it is not subject to sampling error and therefore the RSE (y) is equal to zero.

The standard error spreadsheet available on the ABS web site incorporates the following formula for use in cases where x is a subset of y:

$$\mathrm{RSE}(x/y) = \sqrt{[\mathrm{RSE}(x)]^2 - [\mathrm{RSE}(y)]^2}$$

STANDARD ERROR MODELS FOR MONTHLY MOVEMENT ESTIMATES

For any monthly movement estimate of number of persons, the modelled standard error is given by the following formula (where logarithms are to base 10).

$$\log(\mathrm{SE}) = a + b \times \log(\mathrm{MAXEST}) + c \times [\log(\mathrm{MAXEST})]^2 + d \times [\max\{\log(\mathrm{MAXEST}) - k, 0\}]^2$$

MAXEST represents the larger of the level estimates in the movement pair.

Parameters for monthly movement estimates

The parameters used in the standard error model formula depend on the type of estimate and the area of interest (i.e. Australia or a particular state, territory or region). The following table is divided into three parts, presenting the parameters (a, b, c, d and knot k) for the formula above. This formula and parameters can be used to calculate standard errors for monthly movements in estimates of employed, unemployed and not in the labour force. Standard errors for monthly movement estimates of the labour force can be calculated using the employed parameters. The table includes the parameters for Australia, and the states and territories. Parameters for regions are included in the spreadsheet and are also available upon request.

Note: During the phase-in of the new LFS sample from November 2002 to June 2003, standard errors were higher than those derived from the models — the section 'Introduction of new sample' below provides more information on movement standard errors during this period.

Parameters for monthly movement estimates continued

PARAMETERS TO CALCULATE MONTHLY MOVEMENT STANDARD ERRORS(a)—December 2002 to January 2003 onwards(b)

State or territory	*a*	*b*	*c*	*d*	*k*
Employed					
New South Wales	–4.91419	3.89935	–0.47457	0.52489	3.8
Victoria	–2.51628	2.58378	–0.29988	0.35078	3.8
Queensland	2.19258	0.05266	0.03752	0.51925	6.0
South Australia	1.57697	0.22651	0.02118	0.69240	5.5
Western Australia	1.78354	0.16580	0.02748	0.70147	5.7
Tasmania	1.67079	0.08483	0.04126	0.47533	5.0
Northern Territory	1.26740	0.26888	0.02440	0.14666	4.5
Australian Capital Territory	1.82410	0.00581	0.04993	0.10591	4.9
Australia	–0.78346	1.53105	–0.13789	0.19739	4.5
Unemployed					
New South Wales	0.19208	1.10068	–0.08279	0.08529	3.5
Victoria	0.61766	0.80272	–0.03652	0.06254	4.0
Queensland	1.73475	0.17047	0.05229	–0.04934	3.5
South Australia	0.91312	0.57948	–0.00809	0.00728	3.4
Western Australia	0.96543	0.55298	–0.00085	–0.04031	4.0
Tasmania	0.03175	1.01599	–0.06799	0.02963	3.3
Northern Territory	–6.48012	5.48394	–0.82716	0.88637	3.0
Australian Capital Territory	1.07611	0.36438	0.03602	–0.38367	3.5
Australia	0.90709	0.67547	–0.02258	0.03690	4.0
Not in the labour force					
New South Wales	–6.48319	4.80278	–0.59788	0.66454	3.8
Victoria	–4.29143	3.60092	–0.43908	0.51621	3.8
Queensland	2.40806	–0.01885	0.04653	0.29661	5.7
South Australia	–3.23503	3.20999	–0.43126	0.50332	3.4
Western Australia	1.80980	0.18245	0.02648	0.36387	5.3
Tasmania	1.89603	–0.02746	0.05922	–0.10349	4.7
Northern Territory	0.51182	0.64655	–0.01374	0.00753	4.0
Australian Capital Territory	2.14608	–0.17539	0.08117	0.09339	4.3
Australia	–1.26864	1.80205	–0.17044	0.24874	4.5

(a) For estimates of number of persons

(b) For movement standard errors during phase-in of the new sample between November 2002 and June 2003, see note below.

EXAMPLE

This is an example of how the model formula would be used to calculate the standard error for a monthly movement. The LFS estimate for the number of people employed part time in Australia decreased from 2,815,800 in October 2004 to 2,779,400 in November 2004. The standard error of the difference between the two months' estimates (36,400) can be calculated from the model formula as follows:

$$\begin{aligned}\log(SE) &= a + b \times \log(MAXEST) + c \times [\log(MAXEST)]^2 \\ &\quad + d \times [\max(\log(MAXEST) - k, 0)]^2 \\ &= -0.78346 + 1.53105 \times \log(2{,}815{,}800) - 0.13789 \times [\log(2{,}815{,}800)]^2 \\ &\quad + 0.19739 \times [\max\{\log(2{,}815{,}800) - 4.5, 0\}]^2 \\ &= 4.10561 \\ SE &= 12{,}753\end{aligned}$$

So, the standard error for the estimated monthly movement in the number of people employed part time between October and November 2004 (36,400) is 12,800.

Monthly movement of the unemployment rate

The Taylor Series Expansion formula is used to calculate standard errors for monthly movements of the unemployment rate. This formula takes into account the variance in both the numerator x (estimate of unemployed persons) and the denominator y (estimate of persons in the labour force), and calculates standard errors in percentage points. Note that the standard errors used in this formula are derived from the *level* standard error models and parameters. The spreadsheet includes the following formula to calculate the standard error for monthly movements of the unemployment rate.

$$\left(\frac{SE}{100}\right)^2 = \frac{1}{y_t^2}\left(SE(x_t)\right)^2 + \frac{x_t^2}{y_t^4}\left(SE(y_t)\right)^2 - 0.3 \times \frac{x_t}{y_t^3}SE(x_t)SE(y_t) + \frac{1}{y_{t-1}^2}\left(SE(x_{t-1})\right)^2 + \frac{x_{t-1}^2}{y_{t-1}^4}\left(SE(y_{t-1})\right)^2$$
$$- 0.3 \times \frac{x_{t-1}}{y_{t-1}^3}SE(x_{t-1})SE(y_{t-1}) - 2 \times \left\{0.42 \times \frac{1}{y_t y_{t-1}}SE(x_t)SE(x_{t-1}) + 0.58 \times \frac{x_t x_{t-1}}{y_t^2 y_{t-1}^2}SE(y_t)SE(y_{t-1})\right\}$$

Monthly movement of other rates and percentages

To calculate standard errors for monthly movements of other rates and percentages, use the following formula.

$$SE(\text{monthly movement of } \frac{x}{y}) = SE(\text{monthly movement of } x) \times \frac{MAX\left(\frac{x_t}{y_t}, \frac{x_{t-1}}{y_{t-1}}\right)}{MAX(x_t, x_{t-1})} \times 100$$

The standard error used in this formula is derived from the monthly movement model formula and parameters.

Introduction of new sample

During the introduction of the new LFS sample from November 2002 to June 2003, standard errors for movement estimates were higher than those derived from the model. The bulk of the new sample was phased in over the entire period, with one-eighth of the private dwelling sample in urban areas and less remote areas introduced each month. The remainder of the sample (the private dwelling sample in remote, less-populated areas and the non-private dwelling sample) was introduced in November 2002 for New South Wales, Victoria, Tasmania, Northern Territory and the Australian Capital Territory, and in December 2002 for Queensland, South Australia and Western Australia. Thus, the standard errors were highest in these months, as a larger proportion of the sample was introduced.

Although movement standard errors for the entire phase-in were higher, it was only considered necessary to produce a separate standard error table for these first two months, and this was published in the November and December 2002 issues of *Labour Force, Australia* (cat. no. 6203.0). The spreadsheet on the ABS web site incorporates the standard error model for this phase-in period.

For more information on the LFS sample redesign, see *Information Paper: Labour Force Survey Sample Design* (cat. no. 6269.0).

EXAMPLES OF CALCULATIONS

INTRODUCTION

While it is possible to calculate standard errors using the appropriate model formula and parameters, doing so is time consuming and open to human error. Therefore the ABS has prepared a spreadsheet which uses these formulae to calculate standard errors. The examples presented in this section demonstrate how to use this spreadsheet, which is available free on the ABS website.

The standard error spreadsheet contains worksheets for calculating standard errors for different types of estimates. The examples shown in this paper will indicate which sheet is to be used. The following examples are included in this section:

Standard errors for level or rate estimates:

- How to calculate standard errors for level estimates
- How to calculate standard errors for rates and percentages

Standard errors for monthly movements of estimates:

- How to calculate standard errors for monthly movements of estimates
- How to calculate standard errors for monthly movements of the unemployment rate
- How to calculate standard errors for monthly movements of other rates

Standard errors for averages, aggregates and movements other than monthly:

- How to calculate standard errors for hours worked
- How to calculate standard errors for duration of unemployment
- How to calculate standard errors for averages
- How to calculate standard errors for movements other than monthly

Additional examples:

- How to calculate standard errors for differences
- How to calculate confidence intervals

STANDARD ERRORS FOR LEVEL OR RATE ESTIMATES

To use the spreadsheet to calculate standard errors for level or rate estimates, follow these steps:

Step 1. Choose the right worksheet for the type of estimate

To calculate standard errors and relative standard errors of level or rate estimates for states, territories or Australia, select the sheet 'Level or Rate'. To calculate standard errors of level or rate estimates for LFS regions, choose the sheet labelled 'Region levels'.

Step 2. Enter the time period

Type or paste in the month and year which corresponds to the appropriate time period for the data. The date must be entered in the format mmm-yyyy, for example for February 2004, enter Feb-2004.

Step 3. Select the estimate type

Select the estimate type by clicking on the 'Select estimate type' cell and choosing from the drop-down list. For estimates of the unemployment rate, select 'Unemployed' in column C, and 'Labour force' in column E.

Step 4. Enter the estimate

Enter the level estimate (in thousands of persons) in columns C and E, or the participation rate (as a percentage) in the appropriate column.

STANDARD ERRORS FOR LEVEL OR RATE ESTIMATES *continued*

Step 5. Display of standard error (or relative standard error)

After following the first four steps, the modelled standard error (and relative standard error) will be displayed on the sheet.

Detailed examples are shown on the following pages, which use these steps to calculate standard errors for specific estimate types. It is most useful to read these examples in conjunction with the spreadsheet.

How to calculate standard errors for level estimates

The following example demonstrates how to use the spreadsheet to calculate standard errors for level estimates:

EXAMPLE 1

PERSONS EMPLOYED, NOVEMBER 2004

The LFS estimate for the number of persons employed in Australia in November 2004 was 9,786,500.

To derive a standard error from the spreadsheet, first select the relevant sheet 'Level or Rate'. Now enter the time period in the appropriate format (i.e. Nov-2004) and then select the estimate type 'Employed'. Selecting the cell which corresponds to the correct geography (Australia), enter the level estimate in column C in thousands (9786.5).

The sheet uses the formulas shown in the 'Standard error models' section to calculate the standard error(s). For this example, the standard error of 36,400 will be displayed (in thousands) at the bottom of the page.

The relative standard error (RSE) will also be displayed at the bottom of the page. For this example the RSE will be 0.4%.

How to calculate standard errors for rates and percentages

To calculate standard errors for the unemployment rate and the participation rate, the estimates must be entered differently on the spreadsheet. Select the 'Level or Rate' or 'Region levels' sheet depending on geography and follow the examples below.

EXAMPLE 2A

UNEMPLOYMENT RATE, NOVEMBER 2004

The unemployment rate is calculated as the number of unemployed persons divided by the number of persons in the labour force (i.e. employed plus unemployed). The estimated unemployment rate for November 2004 was 4.9% (unemployed persons estimate 499,000; labour force estimate 10,285,500).

How to calculate standard errors for rates and percentages continued

EXAMPLE 2A *continued*

Using the spreadsheet to calculate the standard error for the unemployment rate of Australia, first select the sheet 'Level or Rate'. Second, enter the relevant time period at the top of the sheet in the format specified (i.e. Nov-2004). Select the estimate type 'Unemployed' in column C and 'Labour force' in column E. Then enter the estimate of number of unemployed persons in column C in thousands (499.0) and the labour force estimate in column E in thousands (10285.5). The unemployment rate as a percentage is then displayed in column G.

Along with the standard error of the unemployment rate, the standard error and RSE of the unemployed and labour force estimates are also displayed. The standard error of the estimated unemployment rate (4.9%) is 0.1 percentage point.

EXAMPLE 2B

PARTICIPATION RATE, NOVEMBER 2004

The labour force participation rate is calculated as the number of persons in the labour force divided by the number of persons in the civilian population aged 15 years and over. In November 2004, the labour force participation rate was estimated to be 63.5%, with 10,285,500 persons in the labour force. Again select the 'Level or Rate' sheet and enter the relevant time period. Select the estimate type 'Labour force' in column C. Then enter the labour force estimate in column C in thousands (10285.5), and the published participation rate (63.5) in column I.

As the denominator is the total civilian population aged 15 years and over (and hence is a population benchmark), its relative standard error is zero. The relative standard error of the participation rate is therefore equal to the relative standard error of the number of persons in the labour force (0.4%). Therefore the standard error of the participation rate (63.5%) is 0.2 percentage points, shown at the bottom of the sheet.

STANDARD ERRORS FOR MONTHLY MOVEMENTS OF ESTIMATES

The techniques used to calculate standard errors for monthly movements of person estimates are similar to those used to calculate standard errors for level estimates. A formula is provided in the 'Standard error models' section to enable calculation of standard errors of monthly movement directly from the standard error model (this is the same formula as used in the spreadsheet).

How to calculate standard errors for monthly movements of estimates

The standard error spreadsheet is able to calculate standard errors of monthly movements of estimates for states, territories and Australia. Parameters to enable calculation of standard errors for monthly movement estimates for regions are available upon request.

To calculate standard errors of monthly movement estimates for states, territories or Australia, select the sheet 'Monthly moves'. After this sheet has been selected, the time period needs to be entered, and the estimate type selected. Then enter the estimate(s) or rate(s) for the consecutive months.

How to calculate standard errors for monthly movements of estimates continued

EXAMPLE 3

PERSONS EMPLOYED PART TIME, OCTOBER TO NOVEMBER 2004

The estimated change in the number of persons employed part time between October 2004 (2,815,800) and November 2004 (2,779,400) was a downward movement of 36,400.

To derive a standard error using the spreadsheet, first enter the time period which relates to the 'current' month (i.e. the later of the pair — Nov-2004 in this case). Then, select the estimate type 'Employed' and in the cells which correspond to the correct geography (Australia), enter, in column C, the estimates relating to each month in thousands (2779.4 and 2815.8).

Both the size of the movement and the associated standard error will be displayed (in thousands) at the bottom of the sheet. For this example, the standard error of the movement was 12,800.

How to calculate standard errors for monthly movements of the unemployment rate

The Taylor Series Expansion formula is used to calculate standard errors for monthly movements of the unemployment rate. This formula takes into account the variance in both the numerator (estimate of unemployed persons) and the denominator (estimate of persons in the labour force), and calculates standard errors in percentage points.

EXAMPLE 4

UNEMPLOYMENT RATE, OCTOBER TO NOVEMBER 2004

In October 2004, the unemployment rate for Australia was 5.0%, the result of 511,000 people being unemployed from a labour force of 10,309,800. One month later the unemployment rate was 4.9% (499,000 people unemployed out of 10,285,500).

In the spreadsheet, select the sheet 'Monthly moves'. Then, enter the time period for the current (or latest) month in the format specified (i.e. Nov-2004). Select the estimate type 'Unemployed' in column C and 'Labour force' in column E. Then, selecting the cells which correspond to the relevant geography (e.g. Australia), enter the estimates of unemployed persons and the labour force for each month in column C and column E respectively. The unemployment rate for each month is then displayed in column G.

The spreadsheet then calculates the standard errors for each of the contributing estimates and uses the formula provided in the 'Standard Error Models' section to produce the standard error for the monthly movement of the unemployment rate in percentage points.

In this example, the standard error for the –0.1 percentage point monthly movement in the unemployment rate between October and November 2004 is 0.1 percentage point.

How to calculate standard errors for monthly movements of other rates

It is also possible to calculate the standard error on monthly movements of rates, where the denominator is a population benchmark, such as the labour force participation rate.

EXAMPLE 5

MALE PARTICIPATION RATE, OCTOBER 2004 TO NOVEMBER 2004

In November 2004, the participation rate of males aged 15 years and over was 71.1%, a result of 5,669,200 people participating in the labour force from a civilian population of 7,969,600. This was a decrease of 0.4 percentage points from the previous month when the participation rate was 71.5% (5,690,100 participating from 7,959,100).

Using the spreadsheet to calculate the standard error, first select the sheet 'Monthly moves' and enter the 'current' (or latest) month in the format specified (i.e. Nov-2004). Then, select the type of estimate 'Labour force' in column C. In the cells which correspond to the appropriate geography (Australia) enter the labour force estimates into column C in thousands, and the published participation rates in column I.

The standard error for the monthly movement of the participation rate is then displayed in percentage points. In this example, the standard error for the –0.4 percentage point monthly movement in the participation rate of males, between October and November 2004, is 0.2 percentage points.

STANDARD ERRORS FOR AVERAGES, AGGREGATES AND MOVEMENTS OTHER THAN MONTHLY

To calculate the standard errors of averages, aggregates and movements other than monthly, factors from table 3 in 'Additional information' are applied to adjust the relative standard error of the level estimate of persons on which the average, aggregate or movement is based. For averages, use the largest of the level estimates from the period being averaged. For movements (e.g. quarterly, annual), use the larger of the two level estimates being compared.

How to calculate standard errors for hours worked

To calculate relative standard errors for aggregate or average hours worked, the RSE for the total number of persons on which the estimate is based is multiplied by the relevant factor from table 3. The resultant RSE can then be converted to a standard error. The spreadsheet incorporates these factors into the calculation of standard errors for averages, aggregates and movements other than monthly on the 'Averages etc' sheet.

EXAMPLE 6

AGGREGATE HOURS WORKED, NOVEMBER 2004

The aggregate number of hours worked per week in November 2004 was estimated to be 338,216,100 hours. This estimate is based on the number of hours worked by all employed persons (9,786,500). Using the spreadsheet to calculate the standard error on the aggregate number of hours worked per week in Australia, select the relevant sheet 'Averages etc' and enter the time period in the format specified (i.e. Nov-2004). Then select the type of estimate 'Employed'.

Enter the level estimate in thousands of persons (9786.5) in the cell which corresponds to the appropriate geography (Aust.). The formula in the spreadsheet will calculate the RSE of this estimate, multiply it by the relevant factor in table 3, and then display the adjusted RSE below the estimate. In this example, the adjusted RSE for the aggregate number of hours worked last week is 0.5%.

How to calculate standard errors for hours worked continued

EXAMPLE 6 *continued*

The approximate standard error of the estimate of aggregate hours worked *in hours* can then be calculated. While the spreadsheet does not include this function, it can easily be achieved by applying the adjusted RSE to the aggregate number of hours. Therefore, the aggregate number of hours worked last week of 338,216,100 hours has a standard error of 1,691,100 hours.

How to calculate standard errors for duration of unemployment

RSEs for estimates of average duration of unemployment and median duration of unemployment can be calculated by applying the relevant factor from table 3 to the RSE of the estimate of number of unemployed persons.

The median duration of unemployment is the duration which divides unemployed persons into two equal groups, one comprising persons whose duration of unemployment is above the median, and the other comprising persons whose duration is below it. In LFS publications, the median duration of unemployment is always expressed as a whole number of weeks.

EXAMPLE 7

MEDIAN DURATION OF UNEMPLOYMENT, NOVEMBER 2004

The number of unemployed persons in Australia in November 2004 was estimated to be 499,000, and their median duration of unemployment was estimated to be 12 weeks. To use the spreadsheet to calculate the standard error on the estimate of median duration of unemployment, select the sheet 'Averages etc' and enter the time period in the format specified (e.g. Nov-2004). Then select the type of estimate 'Unemployed'.

Enter the level estimate in thousands of persons (499.0) in the column which corresponds to the appropriate geography (Aust.). The formula in the spreadsheet will calculate the RSE of this estimate, multiply it by the relevant factor from table 3 and then display the adjusted RSE below the estimate. In this example, the adjusted RSE for the median duration of unemployment is 6.3%.

The approximate standard error of the estimate of median duration of unemployment *in weeks* can then be calculated. While the spreadsheet does not include this function, it can easily be achieved by applying the adjusted RSE to the median duration of unemployment. Therefore, the median duration of unemployment of 12 weeks has a standard error of 0.8 weeks.

How to calculate standard errors for averages

To calculate the standard error for averages (e.g. quarterly average from three consecutive months), use the largest of the level estimates over the period being averaged. The standard error of this largest monthly level estimate is then multiplied by the relevant factor from table 3 to produce an adjusted standard error for the average.

How to calculate standard errors for averages continued

EXAMPLE 8

AVERAGE PERSONS EMPLOYED, QUARTER ENDING DECEMBER 2004

For the quarter ending December 2004, the average number of employed persons was 9,844,100. The estimates for employed persons for each contributing month were:

October 2004: 9,798,800

November 2004: 9,786,500

December 2004: 9,947,100

To use the spreadsheet to calculate a standard error for a quarterly average, first select the 'Averages etc' sheet. Enter the time period in the specified format (Dec-2004) and then select the type of estimate 'Employed'.

Enter the largest level estimate of the contributing months in the column which corresponds to the appropriate geography (Aust.) in thousands (9947.1). The formula in the spreadsheet will calculate the standard error of this estimate, multiply it by the relevant factor from table 3 and then display the adjusted standard error below the estimate in thousands of persons.

In this example, the adjusted standard error for the average persons employed for the quarter ending December 2004 is 31,200 persons.

How to calculate standard errors for movements other than monthly

To calculate standard errors for movements other than monthly (e.g. quarterly), use the larger of the two level estimates being compared. The spreadsheet will then apply the relevant factor from table 3 and display the adjusted standard error.

EXAMPLE 9A

PERSONS EMPLOYED PART-TIME, QUARTER ENDING SEPTEMBER 2004 TO QUARTER ENDING DECEMBER 2004

This example calculates a standard error for the change in the average number of persons employed part-time between the quarter ending September 2004 (2,746,300) and the quarter ending December 2004 (2,799,300), an upward movement of 53,000.

To determine the standard error for the movement between consecutive quarterly averages, first determine which is the larger average estimate of the pair being compared. Enter the time period in the format specified (Dec-2004) and the larger average estimate in the column which corresponds to the geography in thousands (2799.3). The standard error is then calculated and multiplied by the factor for movements between consecutive quarterly averages from table 3. The adjusted standard error is then displayed below the estimate, in thousands.

In this example, the adjusted standard error for the change in the average number of persons employed part-time between the quarters is 15,700 persons.

How to calculate standard errors for movements other than monthly continued

EXAMPLE 9B

PERSONS EMPLOYED PART-TIME, NOVEMBER 2003 TO NOVEMBER 2004

This example calculates a standard error for the estimated change in the number of persons employed part-time between November 2003 (2,724,700) and November 2004 (2,779,400). This represents an upward movement of 54,700.

To determine the standard error for the movement between corresponding months of consecutive years, first determine which is the larger estimate of the pair being compared. Enter the time period in the format specified (Nov-2004) and the estimate in the column which corresponds to the geography in thousands (2779.4). The standard error is then calculated and multiplied by the factor for movements between corresponding months of consecutive years from table 3. The adjusted standard error is then displayed below the estimate, in thousands.

In this example, the adjusted standard error for the movement between corresponding months of consecutive years is 26,800 persons.

ADDITIONAL EXAMPLES

Formulae for the calculation of standard errors for differences and calculation of a confidence interval, are not included on the spreadsheet. However, such formulae may be useful to some users so they have been included here.

How to calculate standard errors for differences

The standard error of the difference between two estimates depends on their standard errors and the correlation between them. When the correlation between two estimates is known (or can be approximated), the standard error of their difference is given by the following formula:

$$SE(x-y) = \sqrt{[SE(x)]^2 + [SE(y)]^2 - 2 \times \text{correlation} \times SE(x)SE(y)}$$

If the correlation is close to zero, an approximate standard error may be calculated by the following formula:

$$SE(x-y) = \sqrt{[SE(x)]^2 + [SE(y)]^2}$$

While the second formula will only be exact for differences between uncorrelated estimates, it is expected to provide a good approximation for differences between estimates from non-overlapping populations (e.g. males and females as in the following example).

How to calculate standard errors for differences continued

EXAMPLE 10

UNEMPLOYMENT RATES FOR MALES AND FEMALES, NOVEMBER 2004

This example involves the difference between unemployment rates for males and females for November 2004, which were 4.8% and 4.9% respectively.

To calculate an approximate standard error of the difference, it is first necessary to obtain the standard error of each of the rates, using the method given in example 2a. This gives the following:

- standard error on the unemployment rate of males = 0.2 percentage points
- standard error on the unemployment rate of females = 0.2 percentage points

Second, calculate the standard error for the difference using the following formula:

$$\begin{aligned} \text{SE(male – female)} &= \sqrt{[\text{SE(male)}]^2 + [\text{SE(female)}]^2} \\ &= \sqrt{[0.2]^2 + [0.2]^2} \\ &= \sqrt{0.04 + 0.04} \\ &= \sqrt{0.08} \\ &= 0.3 \text{ percentage points} \end{aligned}$$

So, the standard error on the difference between unemployment rates for males and females was 0.3 percentage points.

How to calculate confidence intervals

Standard errors can be used to derive confidence intervals, which show the range around the estimate within which the population value is likely to fall, for a given probability.

Confidence interval formula

$$\text{Confidence interval lower bound} = \text{estimate} - (Y \times \text{SE(estimate)})$$
$$\text{Confidence interval upper bound} = \text{estimate} + (Y \times \text{SE(estimate)})$$

Y is a factor which depends on the level of probability associated with a confidence interval.

Most commonly, confidence intervals are constructed for 67%, 95% and 99% levels of probability.

- 67% chance (2 chances in 3) that the population value lies within one standard error of the estimate (Y=1 in the formulae above)
- 95% chance (19 chances in 20) that the population value lies within two standard errors of the estimate (Y=2 in the formulae above)
- 99% chance (99 chances in 100) that the population value lies within three standard errors of the estimate (Y=3 in the formulae above)

How to calculate confidence intervals continued

EXAMPLE 11

PERSONS EMPLOYED, NOVEMBER 2004

The estimate of persons employed in November 2004 was 9,786,500, and as shown in example 1, had a standard error of 36,400. The confidence interval for the unknown population value can be calculated as follows:

For 67% chance:

Confidence interval lower bound = estimate − (Y× SE(estimate))
= 9,786,500 − (1× 36,400)
= 9,750,100

Confidence interval upper bound = estimate + (Y× SE(estimate))
= 9,786,500 + (1× 36,400)
= 9,822,900

Confidence interval = 9,750,100 to 9,822,900

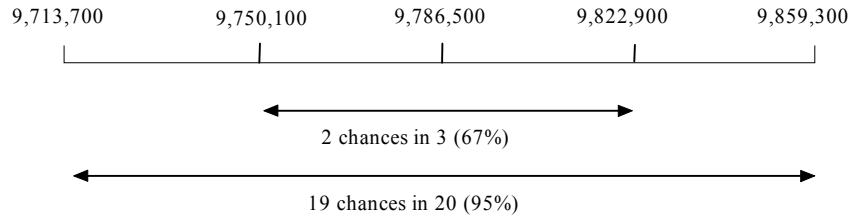
For 95% chance:

Confidence interval lower bound = estimate − (Y× SE(estimate))
= 9,786,500 − (2× 36,400)
= 9,713,700

Confidence interval upper bound = estimate + (Y× SE(estimate))
= 9,786,500 + (2× 36,400)
= 9,859,300

Confidence interval = 9,713,700 to 9,859,300

The following diagram shows these two confidence intervals. The diagram illustrates how the width of the interval increases as the probability of containing the population value increases.



STANDARD ERRORS FOR STATES AND TERRITORIES

SAMPLE SIZES

As noted in the earlier section 'Sample design and survey methodology', the level of accuracy of estimates from the LFS differs between states and territories. To have the same level of accuracy, identical sample sizes would be required for each state and territory. However, the most accurate national estimates would require the sample to be distributed to states and territories in proportion to their populations. In the design of the sample for the LFS, a compromise is made between the accuracy of state and territory estimates and the accuracy of the national estimate. As a result, the sample size and level of accuracy differs between states and territories.

STATE AND TERRITORY STANDARD ERROR MODELS

The standard error models for each state and territory are created in the same way as the Australian model. The difference is that they use estimates relating to a particular state or territory. The standard errors and relative standard errors for state and territory estimates can be calculated in the spreadsheets using the same procedures shown in the examples for national estimates in the previous section.

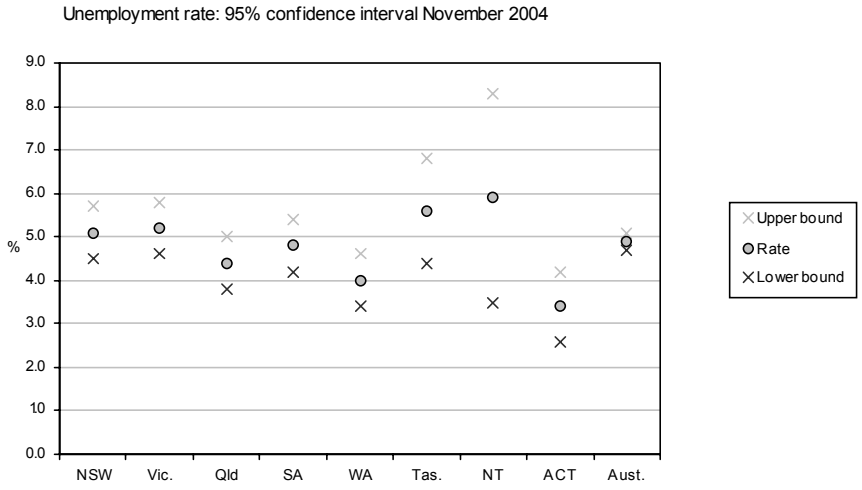
The magnitude of standard errors varies between states and territories. This is shown in the table below, using estimates of the unemployment rate for October and November 2004.

UNEMPLOYMENT RATE

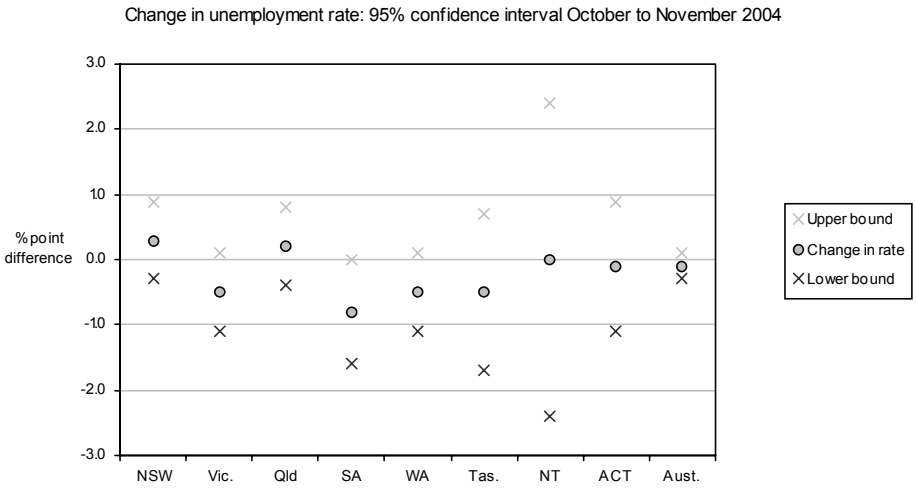
	October 2004	*November 2004*	*Change*	*Standard error November 2004*	*Standard error of movement*
State or territory	%	%	% points	% points	% points
New South Wales	4.8	5.1	0.3	0.3	0.3
Victoria	5.7	5.2	–0.5	0.3	0.3
Queensland	4.2	4.4	0.2	0.3	0.3
South Australia	5.6	4.8	–0.8	0.3	0.4
Western Australia	4.5	4.0	–0.5	0.3	0.3
Tasmania	6.1	5.6	–0.5	0.6	0.6
Northern Territory	5.9	5.9	0.0	1.2	1.2
Australian Capital Territory	3.5	3.4	–0.1	0.4	0.5
Australia	5.0	4.9	–0.1	0.1	0.1

The 95% confidence intervals for the November 2004 unemployment rates in each state and territory, and nationally, are shown in the following graph. Note that the width of the confidence intervals is greater in the smaller states and territories, reflecting the lower level of accuracy associated with their smaller sample sizes. However, the accuracy for the smaller states and territories is better than if the sample was designed for optimal national estimates (i.e. if the same sampling fraction was used in each state and territory).

STATE AND TERRITORY STANDARD ERROR MODELS *continued*



Similarly, 95% confidence intervals can be derived for the change in the unemployment rate between October and November 2004. Again, as shown in the graph below, the width of the confidence intervals is greater in the smaller states and territories.



STANDARD ERROR TABLES FOR LEVEL ESTIMATES

The following three tables show the resulting standard errors when the level standard error models are applied to a selection of estimates of various sizes. A standard error for a specific estimate of persons employed, unemployed or not in the labour force can be interpolated between two bounding estimates shown in tables 1a, 1b and 1c respectively. For standard errors of estimates of persons in the labour force, use the standard error table for employed estimates. While these tables can quickly enable an indication of the magnitude of a standard error, using the formula directly (as in the spreadsheet) will provide a more accurate standard error.

Table 1a

STANDARD ERRORS OF LEVEL ESTIMATES OF EMPLOYED PERSONS(a)(b)—For November 2002 onwards(c)

Size of estimate	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
	no.	no.	no.	no.	no.	no.	no.	no.	no.
100	na	na	na	na	na	90	80	130	na
200	na	na	na	190	200	140	130	160	na
300	na	na	na	230	250	170	160	190	230
500	na	440	440	280	310	210	210	220	320
700	580	500	500	330	360	240	250	240	410
1,000	660	580	570	380	410	280	300	270	510
1,500	770	680	670	440	490	320	350	300	650
2,000	870	760	740	490	550	350	390	320	770
2,500	950	850	800	550	600	350	400	350	850
3,000	1 000	900	850	550	650	400	450	350	950
3,500	1 050	950	900	600	700	400	450	400	1 050
4,000	1 150	1 000	950	650	700	450	500	400	1 100
5,000	1 250	1 100	1 050	700	800	450	550	400	1 250
7,000	1 400	1 250	1 150	800	900	550	650	500	1 450
10,000	1 600	1 400	1 300	850	1 000	600	800	550	1 650
15,000	1 850	1 650	1 500	1 000	1 150	750	1 100	700	1 950
20,000	2 100	1 850	1 650	1 150	1 300	900	1 350	800	2 150
30,000	2 400	2 150	1 900	1 350	1 500	1 150	1 850	1 050	2 500
40,000	2 700	2 400	2 100	1 600	1 650	1 400	2 300	1 250	2 700
50,000	2 900	2 600	2 300	1 800	1 850	1 600	2 800	1 400	2 900
100,000	3 750	3 400	3 150	2 700	2 850	2 450	4 950	1 950	3 750
150,000	4 500	4 100	4 000	3 500	3 850	3 000	7 050	2 200	4 400
200,000	5 200	4 850	4 800	4 100	4 600	3 400	9 100	2 300	4 950
300,000	6 650	6 350	6 350	5 100	5 850	4 050	13 100	2 400	5 950
500,000	9 300	8 700	8 950	6 450	7 400	4 850	. .	. .	7 600
1,000,000	14 000	12 850	12 650	8 400	9 400	5 850	. .	. .	10 850
2,000,000	19 950	18 100	15 450	10 300	10 700	. .	. .	. .	16 050
5,000,000	29 450	26 750	16 200	. .	. .	. .	. .	. .	27 350
10,000,000	37 200	34 100	. .	. .	. .	. .	. .	. .	36 650
15,000,000	. .	. .	. .	. .	. .	. .	. .	. .	41 200

. . not applicable
na not available
(a) Estimates of number of persons for a given month.
(b) For level estimates of persons in the labour force, use this table.
(c) For standard errors in earlier periods, see the 2003 edition of Information Paper: Labour Force Survey Standard Errors (cat.no. 6298.0) or issues of Labour Force, Australia (cat. no. 6203.0 or cat. no. 6202.0) for the relevant period.

Table 1b

STANDARD ERRORS OF LEVEL ESTIMATES OF UNEMPLOYED PERSONS(a)—For November 2002 onwards(b)

Size of estimate	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
	no.	no.	no.	no.	no.	no.	no.	no.	no.
100	na	na	na	na	na	80	70	80	na
200	na	na	na	180	180	130	130	130	na
300	na	na	270	220	230	170	180	170	220
500	420	390	360	290	300	220	260	220	330
700	500	470	430	340	360	270	330	260	420
1,000	600	560	520	400	430	320	400	310	530
1,500	750	680	640	490	530	390	510	380	680
2,000	870	790	750	570	610	460	610	440	790
2,500	950	900	850	650	700	500	700	500	900
3,000	1 050	950	900	700	750	550	800	550	950
3,500	1 150	1 050	1 000	750	800	600	850	600	1 050
4,000	1 200	1 100	1 050	800	850	650	950	650	1 100
5,000	1 350	1 250	1 150	900	950	750	1 100	750	1 200
7,000	1 600	1 450	1 400	1 100	1 150	950	1 350	850	1 400
10,000	1 950	1 750	1 700	1 300	1 400	1 150	1 700	950	1 700
15,000	2 400	2 150	2 050	1 600	1 750	1 400	2 250	1 100	2 050
20,000	2 800	2 500	2 400	1 850	2 000	1 500	. .	. .	2 400
30,000	3 450	3 150	2 950	2 300	2 450	1 550	. .	. .	2 950
40,000	4 050	3 650	3 450	2 600	2 850	1 450	. .	. .	3 400
50,000	4 550	4 150	3 850	2 900	3 150	. .	. .	. .	3 800
100,000	6 650	6 100	5 500	3 900	4 300	. .	. .	. .	5 450
150,000	8 300	7 550	6 750	. .	. .	. .	. .	. .	6 750
200,000	9 750	8 650	7 800	. .	. .	. .	. .	. .	7 900
300,000	12 200	10 150	. .	. .	. .	. .	. .	. .	9 750
500,000	16 250	11 950	. .	. .	. .	. .	. .	. .	12 850
1,000,000	. .	. .	. .	. .	. .	. .	. .	. .	18 750
2,000,000	. .	. .	. .	. .	. .	. .	. .	. .	27 450

. . not applicable

na not available

(a) Estimates of number of persons for a given month.

(b) For standard errors in earlier periods, see the 2003 edition of Information Paper: Labour Force Survey Standard Errors (cat.no. 6298.0) or issues of Labour Force, Australia (cat. no. 6203.0 or cat. no. 6202.0) for the relevant period.

Table 1c

STANDARD ERRORS OF LEVEL ESTIMATES OF PERSONS NOT IN THE LABOUR FORCE(a)—For November 2002 onwards(b)

Size of estimate	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
	no.	no.	no.	no.	no.	no.	no.	no.	no.
100	na	na	na	na	na	90	110	80	na
200	na	na	na	150	180	140	150	130	na
300	na	na	na	200	230	170	180	160	250
500	na	400	380	280	310	220	230	220	340
700	470	480	450	340	370	260	280	250	420
1,000	590	580	540	410	450	300	330	300	520
1,500	750	710	670	490	550	350	400	350	660
2,000	870	810	770	560	630	390	470	380	780
2,500	1 000	900	850	600	700	400	550	400	900
3,000	1 100	1 000	950	650	750	450	600	450	950
3,500	1 150	1 050	1 000	700	800	450	650	450	1 050
4,000	1 250	1 100	1 050	750	850	500	700	450	1 150
5,000	1 400	1 200	1 150	800	900	550	800	500	1 250
7,000	1 600	1 400	1 350	900	1 050	650	1 000	600	1 500
10,000	1 850	1 650	1 550	1 050	1 150	800	1 350	750	1 750
15,000	2 200	1 900	1 800	1 250	1 350	1 000	1 900	1 000	2 150
20,000	2 400	2 100	2 000	1 450	1 550	1 200	2 400	1 150	2 400
30,000	2 800	2 450	2 350	1 750	1 950	1 500	3 350	1 450	2 850
40,000	3 150	2 750	2 600	2 050	2 350	1 750	4 150	1 650	3 200
50,000	3 450	3 000	2 900	2 250	2 700	1 950	4 850	1 800	3 500
100,000	4 800	4 350	4 400	3 300	4 050	2 750	7 850	2 200	4 500
150,000	6 000	5 550	5 750	4 100	5 000	3 250	10 200	. .	5 250
200,000	7 050	6 600	6 850	4 700	5 750	3 650	. .	. .	5 950
300,000	9 100	8 250	8 500	5 600	7 000	4 250	. .	. .	7 300
500,000	12 400	10 750	10 600	6 650	8 700	5 000	. .	. .	9 900
1,000,000	17 550	15 000	13 100	7 900	11 400	. .	. .	. .	15 550
2,000,000	22 850	20 200	14 650	. .	. .	. .	. .	. .	22 700
5,000,000	28 450	28 450	. .	. .	. .	. .	. .	. .	33 000
10,000,000	30 350	35 500	. .	. .	. .	. .	. .	. .	39 700
15,000,000	. .	. .	. .	. .	. .	. .	. .	. .	42 600

. . not applicable
na not available
(a) Estimates of number of persons for a given month.
(b) For standard errors in earlier periods, see the 2003 edition of Information Paper: Labour Force Survey Standard Errors (cat.no. 6298.0) or issues of Labour Force, Australia (cat. no. 6203.0 or cat. no. 6202.0) for the relevant period.

Using the tables for level estimates

To interpolate the standard error of a level estimate from tables 1a, 1b or 1c, first select the table which applies to the estimate type. Then find the 'size of estimate' value closest to the level estimate. When the level estimate falls between two 'size of estimate' values listed in the table (referred to as 'upper value' and 'lower value'), an interpolation factor needs to be calculated using the following formula.

$$\text{Interpolation factor} = \frac{\text{estimate} - \text{lower value}}{\text{upper value} - \text{lower value}}$$

Once the interpolation factor has been calculated, the following formula can then be applied using the standard errors (SEs) corresponding to the upper and lower values in the table.

$$\text{SE(estimate)} = \text{SE(lower)} + (\text{Interpolation factor} \times [\text{SE(upper)} - \text{SE(lower)}])$$

Using the tables for level estimates continued

EXAMPLE

PERSONS EMPLOYED, NOVEMBER 2004

The LFS estimate for the number of persons employed in Australia in November 2004 was 9,786,500.

To derive a standard error, use table 1a, and locate the range in which the estimate falls. In this example, 9,786,500 falls between 5,000,000 (lower value) and 10,000,000 (upper value). Thus, the standard error will lie between 36,650 and 27,350, and can be estimated as follows:

$$\text{Interpolation factor} = \frac{\text{estimate} - \text{lower value}}{\text{upper value} - \text{lower value}}$$
$$= \frac{9{,}786{,}500 - 5{,}000{,}000}{10{,}000{,}000 - 5{,}000{,}000}$$
$$= \frac{4{,}786{,}500}{5{,}000{,}000}$$
$$= 0.96$$

$$\text{SE(estimate)} = \text{SE(lower)} + (\text{interpolation factor} \times [\text{SE(upper)} - \text{SE(lower)}])$$
$$= 27{,}350 + (0.96 \times [36{,}650 - 27{,}350])$$
$$= 27{,}350 + (0.96 \times [9{,}300])$$
$$= 27{,}350 + 8{,}928$$
$$= 36{,}278$$

So, the standard error for the number of employed persons in November 2004 is 36,300. If using the model formula, as incorporated into the spreadsheet on the ABS web site, the standard error will be 36,400.

STANDARD ERROR TABLES FOR MONTHLY MOVEMENT ESTIMATES

The following three tables show the resulting standard errors when the monthly movement standrard error models are applied to a selection of estimates of various sizes. A standard error for a specific monthly movement estimate of persons employed, unemployed or not in the labour force can be interpolated between two bounding estimates shown in tables 2a, 2b and 2c respectively. For standard errors of monthly movement estimates of persons in the labour force, use the standard error table for monthly movement estimates of employed persons. While these tables can quickly enable an indication of the magnitude of a standard error, using the formula directly (as in the spreadsheet) will provide a more accurate standard error.

Table 2a

STANDARD ERRORS OF MONTHLY MOVEMENT ESTIMATES OF EMPLOYED PERSONS(a)(b)—For December 2002 to January 2003 onwards(c)

Size of larger estimate	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
	no.	no.	no.	no.	no.	no.	no.	no.	no.
100	na	na	na	na	na	100	80	110	na
200	na	na	na	160	200	120	100	130	na
300	na	na	na	190	230	140	120	140	150
500	na	190	410	220	270	160	150	160	220
700	220	260	440	250	300	180	170	180	290
1,000	330	340	490	280	340	200	200	200	370
1,500	480	460	550	320	390	230	230	220	490
2,000	600	550	600	350	450	250	250	250	600
2,500	700	650	650	400	450	250	300	250	650
3,000	800	700	650	400	500	300	300	300	750
4,000	950	800	750	450	550	300	350	300	900
5,000	1 050	850	800	500	600	350	400	350	1 000
7,000	1 150	950	900	600	650	400	450	400	1 150
10,000	1 300	1 100	1 000	650	750	450	550	450	1 350
15,000	1 450	1 250	1 150	800	900	550	650	500	1 600
20,000	1 600	1 350	1 300	900	1 000	650	750	600	1 800
30,000	1 850	1 600	1 500	1 050	1 200	750	900	700	2 050
50,000	2 250	1 950	1 850	1 300	1 500	950	1 200	900	2 350
70,000	2 600	2 200	2 150	1 500	1 700	1 100	1 450	1 050	2 650
100,000	3 000	2 550	2 500	1 750	2 000	1 350	1 800	1 250	3 000
150,000	3 550	3 050	2 950	2 050	2 400	1 700	2 400	1 600	3 450
200,000	4 000	3 500	3 350	2 350	2 700	2 100	2 950	1 900	3 850
300,000	4 800	4 250	4 050	2 850	3 300	3 050	4 100	2 450	4 500
500,000	6 150	5 400	5 150	3 850	4 200	5 350	. .	. .	5 600
1,000,000	8 650	7 750	7 250	7 450	6 750	13 800	. .	. .	7 650
2,000,000	12 500	11 300	11 500	19 450	14 900	. .	. .	. .	10 700
5,000,000	21 000	19 200	30 400	. .	. .	. .	. .	. .	17 350
10,000,000	31 800	29 400	. .	. .	. .	. .	. .	. .	25 750
15,000,000	. .	. .	. .	. .	. .	. .	. .	. .	32 850

. . not applicable
na not available
(a) Monthly movement in the estimated number of persons. For standard errors for movements other than monthly, see table 3.
(b) For standard errors of monthly movements in the estimated number of persons in the labour force, use this table.
(c) For standard errors in earlier periods, see the 2003 edition of Information Paper: Labour Force Survey Standard Errors (cat.no. 6298.0) or issues of Labour Force, Australia (cat. no. 6203.0 or cat. no. 6202.0) for the relevant period. For standard errors during phase in of the new sample between November 2002 and June 2003, see note below.

Table 2b

STANDARD ERRORS OF MONTHLY MOVEMENT ESTIMATES OF UNEMPLOYED PERSONS(a)—For December 2002 to January 2003 onwards(b)

Size of larger estimate	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
	no.	no.	no.	no.	no.	no.	no.	no.	no.
100	na	na	na	na	na	60	20	90	na
200	na	na	na	160	170	100	60	130	na
300	na	na	300	200	210	140	110	160	280
500	360	330	380	260	280	190	200	210	370
700	450	400	440	310	340	240	270	250	440
1,000	560	500	520	380	410	290	340	310	540
1,500	710	630	640	470	520	370	420	400	670
2,000	850	750	750	550	600	450	500	450	800
2,500	950	850	850	600	700	500	550	550	850
3,000	1 050	950	900	700	750	550	600	600	950
4,000	1 200	1 100	1 050	800	900	650	750	700	1 100
5,000	1 350	1 200	1 200	900	1 000	750	850	800	1 250
7,000	1 600	1 450	1 450	1 050	1 200	850	1 000	900	1 500
10,000	1 950	1 750	1 750	1 250	1 450	1 050	1 300	1 050	1 750
15,000	2 400	2 150	2 150	1 550	1 800	1 300	1 650	1 100	2 150
20,000	2 800	2 500	2 550	1 850	2 100	1 500	. .	. .	2 500
30,000	3 500	3 100	3 150	2 250	2 600	1 800	. .	. .	3 050
50,000	4 550	4 100	4 150	2 950	3 350	2 300	. .	. .	4 000
70,000	5 450	4 950	5 000	3 500	3 950	. .	. .	. .	4 750
100,000	6 550	6 050	6 050	4 250	4 650	. .	. .	. .	5 700
150,000	8 150	7 600	7 600	. .	. .	. .	. .	. .	7 050
200,000	9 500	8 950	8 850	. .	. .	. .	. .	. .	8 250
300,000	11 750	11 350	. .	. .	. .	. .	. .	. .	10 250
500,000	15 450	15 350	. .	. .	. .	. .	. .	. .	13 500
1,000,000	. .	. .	. .	. .	. .	. .	. .	. .	19 700
2,000,000	. .	. .	. .	. .	. .	. .	. .	. .	29 000

. . not applicable

na not available

(a) Monthly movement in the estimated number of persons. For standard errors for movements other than monthly, see table 3.

(b) For standard errors in earlier periods, see the 2003 edition of Information Paper: Labour Force Survey Standard Errors (cat.no. 6298.0) or issues of Labour Force, Australia (cat. no. 6203.0 or cat. no. 6202.0) for the relevant period. For standard errors during phase in of the new sample between November 2002 and June 2003, see note below.

Table 2c

STANDARD ERRORS OF MONTHLY MOVEMENT ESTIMATES OF PERSONS NOT IN THE LABOUR FORCE(a)—For December 2002 to January 2003 onwards(b)

Size of larger estimate	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
	no.	no.	no.	no.	no.	no.	no.	no.	no.
100	na	na	na	na	na	120	60	130	na
200	na	na	na	70	230	140	80	150	na
300	na	na	na	120	270	160	110	160	140
500	na	170	500	190	310	180	140	180	230
700	220	250	540	260	350	200	170	200	300
1,000	350	360	590	330	390	220	210	220	400
1,500	550	520	660	410	450	260	270	260	540
2,000	700	650	700	450	500	300	300	300	650
2,500	850	750	750	500	550	300	350	300	750
3,000	950	850	800	500	600	350	400	350	850
4,000	1 150	950	900	550	650	350	450	350	1 050
5,000	1 250	1 050	950	600	700	400	500	400	1 150
7,000	1 400	1 150	1 050	700	800	450	600	450	1 400
10,000	1 550	1 300	1 200	750	900	550	750	550	1 650
15,000	1 750	1 450	1 400	900	1 100	650	950	650	1 900
20,000	1 900	1 600	1 550	1 000	1 200	750	1 100	800	2 150
30,000	2 200	1 850	1 800	1 200	1 450	900	1 350	1 000	2 400
50,000	2 650	2 250	2 200	1 500	1 800	1 200	1 800	1 350	2 800
70,000	3 000	2 600	2 550	1 750	2 050	1 400	2 100	1 700	3 100
100,000	3 450	3 000	3 000	2 100	2 400	1 700	2 550	2 200	3 500
150,000	4 150	3 650	3 600	2 600	2 900	2 050	3 150	. .	4 050
200,000	4 700	4 200	4 150	3 050	3 300	2 400	. .	. .	4 500
300,000	5 700	5 150	5 000	3 800	4 100	2 900	. .	. .	5 300
500,000	7 350	6 800	6 500	5 150	5 850	3 650	. .	. .	6 650
1,000,000	10 600	10 150	9 900	8 000	10 850	. .	. .	. .	9 300
2,000,000	15 800	15 650	17 550	. .	. .	. .	. .	. .	13 350
5,000,000	27 850	29 200	. .	. .	. .	. .	. .	. .	22 750
10,000,000	44 150	48 550	. .	. .	. .	. .	. .	. .	35 400
15,000,000	. .	. .	. .	. .	. .	. .	. .	. .	46 500

. . not applicable
na not available
(a) Monthly movement in the estimated number of persons. For standard errors for movements other than monthly, see table 3.
(b) For standard errors in earlier periods, see the 2003 edition of Information Paper: Labour Force Survey Standard Errors (cat.no. 6298.0) or issues of Labour Force, Australia (cat. no. 6203.0 or cat. no. 6202.0) for the relevant period. For standard errors during phase in of the new sample between November 2002 and June 2003, see note below.

Using the tables for monthly movement estimates

The techniques used to calculate standard errors for estimates of monthly movements are similar to those used to calculate standard errors for level estimates. The calculation of a standard error of a monthly movement from the tables uses the *larger* of the two level estimates that are being differenced to calculate the movement. To interpolate the standard error of the larger estimate from tables 2a, 2b or 2c, first select the table which applies to the estimate type. Then find the 'size of estimate' value closest to the larger estimate. When the larger estimate falls between two 'size of estimate' values listed in the table (referred to as 'upper value' and 'lower value'), an interpolation factor needs to be calculated using the following formula.

$$\text{Interpolation factor} = \frac{\text{estimate} - \text{lower value}}{\text{upper value} - \text{lower value}}$$

Using the tables for monthly movement estimates continued

Once the interpolation factor has been calculated, the following formula can then be applied using the standard errors (SEs) corresponding to the upper and lower values in the table.

$$SE(estimate) = SE(lower) + (Interpolation\ factor \times [SE(upper) - SE(lower)])$$

EXAMPLE

PERSONS EMPLOYED PART TIME, OCTOBER TO NOVEMBER 2004

This example calculates a standard error for the estimated change in the number of persons employed part time between October 2004 (2,815,800) and November 2004 (2,779,400). This represents a downward movement of 36,400.

The calculation of a standard error of a monthly movement uses the larger of the two level estimates. In this example, the larger estimate is October 2004 with 2,815,800 persons.

For this example, use table 2a for standard errors of monthly movements in estimates of employed persons. To derive a standard error from table 2a, first locate the range in which the larger of the two estimates falls. Here, the larger of the estimates (2,815,800) falls between values 2,000,000 (lower) and 5,000,000 (upper). Thus, table 2a shows that the standard error for the monthly movement will lie between 10,700 and 17,350, and can be calculated as follows.

First, calculate the interpolation factor:

$$\begin{aligned} \text{Interpolation factor} &= \frac{\text{estimate} - \text{lower value}}{\text{upper value} - \text{lower value}} \\ &= \frac{2{,}815{,}800 - 2{,}000{,}000}{5{,}000{,}000 - 2{,}000{,}000} \\ &= \frac{815{,}800}{3{,}000{,}000} \\ &= 0.27 \end{aligned}$$

Second, calculate the standard error for a monthly movement.

$$\begin{aligned} SE(estimate) &= SE(lower) + (interpolation\ factor \times [SE(upper) - SE(lower)]) \\ &= 10{,}700 + (0.27 \times [17{,}350 - 10{,}700]) \\ &= 10{,}700 + (0.27 \times [6{,}650]) \\ &= 10{,}700 + 1{,}796 \\ &= 12{,}496 \end{aligned}$$

So the standard error for the estimated change in the number of persons employed part time between October and November 2004 is 12,500.

If using the model formula, as incorporated into the spreadsheet on the ABS web site, the standard error for the monthly movement between October and November 2004 is 12,800.

Introduction of new sample

During the introduction of the new LFS sample from November 2002 to June 2003, standard errors for movement estimates were higher than those presented in these tables. In this period, the standard errors were highest in the first two months, when a larger proportion of the new sample was introduced.

As a result:

- a separate movement standard error table was produced for the first two months, and this was published in the November and December 2002 issues of *Labour Force, Australia* (cat. no. 6203.0). The spreadsheet available on the ABS web site incorporates the standard error model for this phase-in period.
- although movement standard errors for the remainder of the sample implementation period would have been slightly higher than those shown in tables 2a, 2b and 2c, no separate standard error table was produced for those months.

FACTORS FOR OTHER ESTIMATES

To calculate standard errors for estimates such as hours worked, duration of unemployment and movements other than monthly, a factor is applied to the standard error (or RSE) of the contributing estimate. These factors are shown in table 3 below, followed by an explanation on how to apply them. The factors are also incorporated into the spreadsheet available on the ABS web site.

Table 3

FACTORS FOR OTHER ESTIMATES, AUSTRALIA(a), For November 2002 onwards(b)

Estimate type(c)	*Factor*	*Apply to*
Averages:		
Average duration of unemployment	1.57	RSE for estimated number of persons
Median duration of unemployment	2.46	RSE for estimated number of persons
Average hours worked last week, employed persons	0.76	RSE for estimated number of persons
Quarterly average (3 consecutive months) of employed persons	0.85	SE for largest monthly estimate of persons
Quarterly average (3 consecutive months) of unemployed persons	0.71	SE for largest monthly estimate of persons
Quarterly average (3 consecutive months) of persons not in the labour force	0.83	SE for largest monthly estimate of persons
Annual average (12 consecutive months) of employed persons	0.60	SE for largest monthly estimate of persons
Annual average (12 consecutive months) of unemployed persons	0.42	SE for largest monthly estimate of persons
Annual average (12 consecutive months) of persons not in the labour force	0.58	SE for largest monthly estimate of persons
Aggregates of:		
Hours worked last week, employed persons	1.28	RSE for estimated number of persons
Duration of unemployment in weeks, unemployed persons	1.82	RSE for estimated number of persons
Movements between:		
Consecutive quarterly averages of employed persons	0.80	SE for larger average estimate of persons(d)
Consecutive quarterly averages of unemployed persons	0.78	SE for larger average estimate of persons(d)
Consecutive quarterly averages of persons not in the labour force	0.78	SE for larger average estimate of persons(d)
Consecutive 12-monthly averages of employed persons	0.75	SE for larger average estimate of persons(d)
Consecutive 12-monthly averages of unemployed persons	0.55	SE for larger average estimate of persons(d)
Consecutive 12-monthly averages of persons not in the labour force	0.73	SE for larger average estimate of persons(d)
Corresponding months of consecutive quarters, employed persons	1.08	SE for larger estimate of persons
Corresponding months of consecutive quarters, unemployed persons	1.21	SE for larger estimate of persons
Corresponding months of consecutive quarters, persons not in the labour force	1.08	SE for larger estimate of persons
Corresponding months of consecutive years, employed persons	1.37	SE for larger estimate of persons
Corresponding months of consecutive years, unemployed persons	1.34	SE for larger estimate of persons
Corresponding months of consecutive years, persons not in the labour force	1.37	SE for larger estimate of persons

(a) These factors apply to estimates of persons only.
(b) For factors for earlier periods, see Information Paper: Labour Force Survey Standard Errors, 2003 (cat. no. 6298.0).
(c) For estimates of persons in the labour force, use factors for employed persons.
(d) Calculate the standard error for the larger average estimate of persons by treating the quarterly (or annual) average as a level monthly estimate.

Applying factors for hours worked or duration of unemployment

To calculate the Relative Standard Error (RSE) for estimates of hours worked or duration of unemployment, determine the RSE for the estimate of the number of persons on which the estimate is based (that is, the number of employed persons relating to an hours worked estimate, or the number of unemployed persons relating to a duration of unemployment estimate), and then apply the factor in table 3 to that RSE. This will give an approximate RSE for the estimate of interest. If required, this RSE can then be used to determine an approximate standard error. See examples 6 and 7 for more information.

Applying factors for averages

Factors for averages across time enable the calculation of standard errors for quarterly or annual averages, which are commonly used as a smoothing technique. To calculate standard errors for quarterly or annual averages, multiply the standard error (in persons) of the largest contributing month by the appropriate factor shown in table 3. See example 8 for more information.

Applying factors for movements

Factors for movements enable the calculation of standard errors for movements other than monthly. The two main types of movements for which factors are available are movements between consecutive averaged periods, and movements between corresponding months of consecutive time periods (i.e. quarters or years).

To calculate standard errors for movements between consecutive quarterly or annual averages, first obtain the standard error of the larger averaged estimate, by treating it as a level monthly estimate. Then, multiply this standard error by the appropriate factor shown in table 3. See example 9a for more information.

To calculate standard errors for movements between corresponding months of consecutive time periods (i.e. quarters or years), multiply the standard error of the larger estimate by the appropriate factor in table 3. See example 9b for more information.

LEVELS AT WHICH ESTIMATES HAVE AN RSE OF 25%

The following table provides an indication of whether a particular estimate has an RSE greater or less than 25%. Estimates with an RSE of 25% or greater are not considered to be sufficiently reliable for most purposes, and should be treated with caution. The numbers in table 4 relate to estimates of persons, and any estimate based on fewer persons than the level indicated in the table has an estimated RSE of 25% or greater. For most estimates, the cut-offs for 'all other estimates' should be used — separate cut-offs are given for estimates of hours worked and duration of unemployment.

Table 4

LEVELS AT WHICH LFS ESTIMATES HAVE A RELATIVE STANDARD ERROR OF 25%—November 2002 onwards(a)

	NSW	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
Estimates of:(b)(c)	no.	no.	no.	no.	no.	no.	no.	no.	no.
Aggregate hours worked	7 250	6 060	5 390	2 900	3 560	1 700	1 840	1 560	7 630
Average hours worked	3 020	2 570	2 300	1 240	1 510	720	580	740	2 750
Average duration of unemployment	12 400	10 280	8 830	5 360	5 710	3 160	3 070	3 030	11 310
Median duration of unemployment	44 590	38 540	34 620	23 710	25 260	18 530	35 310	9 330	27 910
All other estimates of employed persons	4 870	3 960	3 710	1 960	2 340	1 170	1 350	1 090	4 830
All other estimates of unemployed persons	6 010	4 890	4 410	2 610	3 020	1 660	3 340	1 500	4 740
All other estimates of persons not in the labour force	6 030	4 800	4 410	2 410	2 990	1 350	1 760	1 320	5 130

(a) For standard errors in earlier periods, see the 2003 edition of Information Paper: Labour Force Survey Standard Errors (cat.no. 6298.0) or issues of Labour Force, Australia (cat. no. 6203.0 or cat. no. 6202.0) for the relevant period.

(b) The entries in this table refer to the number of persons contributing to the estimate.

(c) For estimates of persons in the labour force, use 'All other estimates of employed persons'.

EXAMPLE

UNEMPLOYED PERSONS AGED 15–19 YEARS ATTENDING SCHOOL AND LOOKING FOR FULL-TIME WORK, NOVEMBER 2004

In November 2004, an estimated 8,900 persons aged 15–19 years attending school were unemployed and looking for full-time work. From table 4, the level at which an estimate of unemployed persons has an RSE greater than 25% is 4,740. As the estimate of interest is greater than 4,740, it has an RSE of less than 25%.

The estimate for average duration of unemployment for the same group (unemployed persons aged 15–19 years attending school and looking for full-time work) was 31.6 weeks. Referring to table 4 shows that the 25% RSE cut-off for estimates of average duration of unemployment is 11,310 persons. The estimated number of persons contributing to the estimate of 31.6 weeks is 8,900, which is less than the cut-off of 11,310. Thus, the RSE on the estimate of average duration of unemployment for persons aged 15–19 years looking for full-time work is greater than 25%, and the estimate should be used with caution.

GLOSSARY

Aggregate hours worked — The total number of hours a group of employed persons has actually worked during the reference week, not necessarily hours paid for.

Average duration of unemployment — For any group of unemployed persons, the total duration of unemployment of the group divided by the number of persons in the group.

Average hours worked — Aggregate hours worked by a group of employed persons divided by the number of persons in that group.

Civilian population aged 15 years and over — All usual residents of Australia aged 15 years and over except members of the permanent defence forces, certain diplomatic personnel of overseas governments customarily excluded from census and estimated population counts, overseas residents in Australia, and members of non-Australian defence forces (and their dependants) stationed in Australia.

Confidence interval — An interval, centred on the estimate, with a prescribed level of probability that it includes the true population value.

Correlation — Correlation is a measure of the relationship between two variables, and takes values in the range -1 to 1. The correlation will be effectively zero if the two estimates are based on independent subgroups of the sample (e.g. males and females, or different states). Two estimates of the same subgroup (e.g. employed females) for different time points are positively correlated. Due to sample rotation, the estimates will have lower correlation the longer they are apart.

Employed — All persons aged 15 years and over who, during the reference week:

- worked for one hour or more for pay, profit, commission or payment in kind in a job or business, or on a farm (comprising employees, employers and own account workers); or
- worked for one hour or more without pay in a family business or on a farm (i.e. contributing family workers); or
- were employees who had a job but were not at work and were
  - away from work for less than four weeks up to the end of the reference week; or
  - away from work for more than four weeks up to the end of the reference week and received pay for some or all of the four week period to the end of the reference week; or
  - away from work as a standard work or shift arrangement; or
  - on strike or locked out; or
  - on workers' compensation and expected to return to their job; or
- were employers or own account workers who had a job, business or farm, but were not at work.

Full-time workers — Employed persons who usually worked 35 hours or more a week (in all jobs) and those who, although usually working less than 35 hours a week, worked 35 hours or more during the reference week.

Group jack-knife method — This method of calculating standard errors starts by dividing the survey sample into a number of approximately equal-sized groups (replicate groups). Replicate estimates of the population total are then calculated from the sample by excluding each replicate group in turn. The jack-knife variance is derived from the variation of the respective replicate estimates around the estimate based on the whole sample.

Labour force — For any group, persons who were employed or unemployed, as defined.

Labour force status — A classification of the civilian population aged 15 years and over into employed, unemployed or not in the labour force, as defined. The definitions conform closely to the international standard definitions adopted by the International Conferences of Labour Statisticians.

Median duration of unemployment — The duration which divides unemployed persons into two equal groups: one comprising persons whose duration of unemployment is above the median; and the other, persons whose duration is below it.

Non-sampling error — Arises from imperfections in reporting, recording or processing of the data that can occur in any survey or census.

Not in the labour force — Persons who were not in the categories employed or unemployed as defined.

Participation rate — For any group, the labour force expressed as a percentage of the civilian population aged 15 years and over in the same group.

Part-time workers — Employed persons who usually worked less than 35 hours a week (in all jobs) and either did so during the reference week, or were not at work in the reference week.

Population benchmarks — Labour Force Survey estimates of persons employed, unemployed and not in the labour force are calculated in such a way as to add up to an independently estimated distribution of the usually resident civilian population aged 15 years and over. The independent population estimates (benchmarks) are the latest available estimates at the time the Labour Force Survey is conducted, but they usually differ from the official population estimates subsequently published in *Australian Demographic Statistics* (cat. no. 3101.0) because they are derived from incomplete information about population changes.

Population value — The value that would be obtained if the whole population were enumerated under the same procedures as used in the sample survey.

Relative standard error (RSE) — The relative standard error is the standard error expressed as a percentage of the estimate to which it refers, and is useful when comparing the variability of population estimates of different sizes.

Sampling error — The difference between an estimate based on a sample, and the (unknown) population value.

Standard error (SE) — A measure of the variation among the estimates from all possible samples, and thus a measure of the precision with which an estimate from a particular sample approximates the average result of all possible samples. It is the square root of the variance. The units of the standard error are the same as the variable of interest.

Taylor Series Expansion formula — The Taylor Series Expansion formula is used to provide a reasonable approximation of the variation of a function of variables. This formula is specified in terms of the variance and correlation between variables of that function.

Unemployed — Persons aged 15 years and over who were not employed during the reference week, and:
- had actively looked for full-time or part-time work at any time in the four weeks up to the end of the reference week and were available for work in the reference week; or
- were waiting to start a new job within four weeks from the end of the reference week and could have started in the reference week if the job had been available then.

Unemployment rate — For any group, the number of unemployed persons expressed as a percentage of the labour force in the same group.

FOR MORE INFORMATION . . .

INTERNET	**www.abs.gov.au** the ABS web site is the best place to start for access to summary data from our latest publications, information about the ABS, advice about upcoming releases, our catalogue, and Australia Now—a statistical profile.
LIBRARY	A range of ABS publications is available from public and tertiary libraries Australia-wide. Contact your nearest library to determine whether it has the ABS statistics you require, or visit our web site for a list of libraries.
CPI INFOLINE	For current and historical Consumer Price Index data, call 1902 981 074 (call cost 77c per minute).
DIAL-A-STATISTIC	This service now provides only current Consumer Price Index statistics call 1900 986 400 (call cost 77c per minute).

INFORMATION SERVICE

Data already published that can be provided within five minutes will be free of charge. Our information consultants can also help you to access the full range of ABS information—ABS user pays services can be tailored to your needs, time frame and budget. Publications may be purchased. Specialists are on hand to help you with analytical or methodological advice.

PHONE	1300 135 070
EMAIL	client.services@abs.gov.au
FAX	1300 135 211
POST	Client Services, ABS, GPO Box 796, Sydney NSW 2001

FREE ACCESS TO PUBLICATIONS

All ABS publications can be downloaded free of charge from the ABS web site.

WEB ADDRESS www.abs.gov.au

2629800001055
ISBN 0 642 47850 3

RRP $10.00